THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 25

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte VEMULAPALLI D. N. RAO, HARRY A. CIKANEK,

DANIEL GERMAN and DANIEL M. KABAT

Appeal No. 96-3374
Application No. 08/115,974[1]

ON BRIEF

Before McCANDLISH, Senior Administrative Patent Judge, and MEISTER and NASE, Administrative Patent Judges.

NASE, Administrative Patent Judge.

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[1] Application for patent filed September 3, 1993.

DECISION ON APPEAL

This is a decision on appeal from the examiner's final rejection of claims 1 through 3, 5 through 18 and 20, which are all of the claims pending in this application.

We AFFIRM-IN-PART and enter new rejections pursuant to 37 CFR § 1.196(b).

BACKGROUND

The appellants' invention relates to a low friction cam shaft. Claims 1, 13 and 20 are representative of the subject matter on appeal and copies of those claims are attached to this decision.

The prior art references of record relied upon by the examiner as evidence of obviousness under 35 U.S.C. § 103 are:

Lachnit	3,958,541	May 25, 1976
Lehtinen et al. (Lehtinen)	4,558,960	Dec. 17, 1985
Umeha et al. (Umeha)	4,644,912	Feb. 24, 1987
Oda	4,871,266	Oct. 3, 1989
Rao et al. (Rao)	4,872,432	Oct. 10, 1989
Hiraoka et al. (Hiraoka)	4,969,262	Nov. 13, 1990

Claims 1 through 3, 5 through 7, 9 and 12 through 16 stand rejected under 35 U.S.C. § 103 as being unpatentable over Oda in view of Hiraoka and Rao.

Claims 8, 10 and 17 stand rejected under 35 U.S.C. § 103 as being unpatentable over Oda in view of Hiraoka, Rao and Umeha.

Claims 11, 18 and 20 stand rejected under 35 U.S.C. § 103 as being unpatentable over Oda in view of Hiraoka, Rao, Umeha, Lehtinen and Lachnit.

Rather than reiterate the conflicting viewpoints advanced by the examiner and the appellants regarding the § 103 rejections, we make reference to the final rejection (Paper No. 12, mailed January 30, 1995) and the examiner's answer (Paper No. 21, mailed March 4, 1996) for the examiner's complete reasoning in support of the rejections, and to the appellants' brief (Paper No. 20, filed December 28, 1995) and reply brief (Paper No. 22, filed April 8, 1996) for the appellants' arguments thereagainst.

OPINION

In reaching our decision in this appeal, we have given careful consideration to the appellants' specification and claims, to the applied prior art references, and to the respective positions articulated by the appellants and the examiner. As a consequence of our review, we make the determinations which follow.

The obviousness issue

The test for obviousness is what the combined teachings of the references would have suggested to one of ordinary skill in the art. See In re Young, 927 F.2d 588, 591, 18 USPQ2d 1089, 1091 (Fed. Cir. 1991) and In re Keller, 642 F.2d 413, 425, 208 USPQ 871, 881 (CCPA 1981). Moreover, in evaluating such references it is proper to take into account not only the specific teachings of the references but also the inferences which one skilled in the art would reasonably be expected to draw therefrom. In re Preda, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968).

The appellants have provided three groups of claims as follows: Group I, claims 1 through 3 and 5 through 12; Group II, claims 13 through 18; and Group III, claim 20. See pages 5-7 of the appellants' brief. In accordance with 37 CFR § 1.192(c)(7), we have selected claims 1, 13 and 20 from the appellants' three groups of claims to decide the appeal on the rejections under
35 U.S.C. § 103.

Claim 1

We will sustain the rejection of claim 1 under 35 U.S.C. § 103.

Independent claim 1 sets forth a low friction cam shaft comprising, inter alia, a shaft member and a cam secured to the shaft member. The cam has a base circle portion and a lobe portion made of one metal material having one density. The base circle portion has an interior portion made of another metal material of another density. The interior portion has a porosity less than the lobe portion and the remainder of the base circle portion. The base circle portion and the lobe portion have an outer surface with an open porosity and a solid film lubricant is impregnated in the open porosity of that outer surface of the cam.

As shown in Figure 2, Oda discloses a tappet cam assembly including a metal cam 11 and a ceramic tappet 13. The outer surface of the metal cam 11 is coated with a solid lubricant and a binder 12 to provide excellent wear-resisting and

friction-resisting performances can be obtained even at high temperature with dry conditions in which engines are used.[2]

Rao discloses to decrease the friction between an annular body 20 on a piston 13 and an opposing cylinder wall 12, a solid film lubricant coating 35 (see Figure 6) containing either BN or MoS_2 with graphite may be applied to the cylinder wall. Rao teaches that this coating comprises about 40% by weight of a high temperature thermoplastic resin such as polyarylsulfone, 40% graphite, and 20% of either MoS_2 or BN. Rao further discloses that a suitable resin that is thermally stable up to about 700°F. is polymer 360, known as Astrel, manufactured by Minnesota Mining and Manufacturing Company. Rao teaches that after the cylinder wall surface is thoroughly cleaned to remove any oxidation, such wall may be grit blasted to increase porosity and thereby the reception of the coating.[3] Rao discloses that BN will break down as a structural solid at about 750°F. and MoS_2 will do so at about

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[2] See column 5, lines 32-35, and column 6, lines 3-11, of Oda.

[3] See column 6, lines 10-28, of Rao.

600°F. Rao further teaches that to permit such substances to continue providing antifriction characteristics after such breakdown, the supporting surface may be provided with reservoirs 43 or grooves to capture or retain the solid film lubricant coating 44, much in the manner of porosity.[4]

As shown in Figures 1 and 2, Hiraoka discloses that two different liquid phase sinterable materials A and B are molded into a green cam piece composed of outer and inner layers, which are respectively formed out of the materials A and B. Hiraoka teaches that the outer-layer forming material A is of Fe-C-Ni-Cr-Mo system alloy which is prepared to have a shrinkage of 8% with respect to the axial direction of a camshaft. Hiraoka further teaches that the inner-layer forming material B is of Fe-C-P or Fe-C-P-Mo system alloy which is prepared to have a shrinkage of 4% with respect to the axial direction. As shown in Figure 3, the green cam piece is assembled to a steel shaft

[4] See column 6, lines 48-57, of Rao.

10. Thereafter, the assembly is sintered at a predetermined temperature in which a liquid phase yields to form a cam piece 20 sintered on the shaft.[5] Hiraoka further discloses that in general, the material B is more fluidal and easily compacted to a high density than the material A. When both materials A and B are filled to the same height in molding, there is a tendency that the material B has a higher density than the material A. Therefore, when the material B is filled to half the axial height of the material A, the material B is much more dense than the material A. The higher the density, the lower the shrinkage. Hiraoka states that this means that the materials A and B are easily prepared to have the respectively desired shrinkages which differ by a preselected value from each other.[6]

After the scope and content of the prior art are determined, the differences between the prior art and the

[5] See column 3, lines 46-59, of Hiraoka.

[6] See column 4, lines 17-28, of Hiraoka.

claims at issue are to be ascertained. Graham v. John Deere Co., 383 U.S. 1, 17-18, 148 USPQ 459, 467 (1966).

Based on our analysis and review of Oda and claim 1, it is our opinion that the differences between Oda and claim 1 are the limitations that (1) the cam is made of a plurality of metal materials wherein the base circle portion and the lobe portion of the cam are made of a metal material having one density and the base circle portion has an interior portion made of another metal material of another density and has a porosity less than the lobe portion and the remainder of the base circle portion, and (2) a solid film lubricant is impregnated in the porosity of the outer surface of the base circle portion and the lobe portion to promote rapid formation of a stable oil film to reduce friction.

In applying the above noted test for obviousness, we reach the conclusion that it would have been obvious to one of ordinary skill in the art at the time of the appellants' invention to make Oda's cam of two metal layers of different densities as taught by Hiraoka. Additionally, it would have

been obvious to one of ordinary skill in the art at the time of the appellants' invention to utilize the solid film lubricant of Rao[7] (which impregnates the surface) for the solid film lubricant on the outer surface of Oda's modified cam to further decrease friction.

The arguments advanced by the appellants (brief, pp. 11-14 and reply brief, pp. 2-3) do not persuade us that claim 1 is unobvious over the applied prior art for the following reasons. First, as to the appellants arguments regarding the deficiencies of each reference on an individual basis, we note that nonobviousness cannot be established by attacking the references individually when the rejection is predicated upon a combination of prior art disclosures. See In re Merck & Co. Inc., 800 F.2d 1091, 1097, 231 USPQ 375, 380 (Fed. Cir. 1986). Lastly, the appellants argue that there is no suggestion to combine the references absent the application of impermissible

[7] Particularly since the solid film lubricant disclosed by Rao is the same as the solid film lubricant disclosed by the appellants, there is a reasonable basis to conclude that the solid film lubricant 35 of Rao inherently has an affinity for oil and promotes rapid formation of a stable oil film to reduce friction.

hindsight. However, it is our opinion as set forth above that the applied prior art does provide the suggestion or motivation to make the selection made by the appellants. The extent to which such suggestion must be explicit in, or may be fairly inferred from, the references, is decided on the facts of each case, in light of the prior art and its relationship to the appellants' claimed invention. It is our determination that Hiraoka and Rao suggest the desirability, and thus the obviousness, of modifying Oda to make the claimed combination.

Claims 2, 3 and 5 through 12

As set forth previously, the appellants have grouped claims 1 through 3 and 5 through 12 as standing or falling together. Thereby, in accordance with 37 CFR § 1.192(c)(7), dependent claims 2, 3 and 5 through 12 fall with independent claim 1. Thus, it follows that the examiner's rejections of claim 2, 3 and 5 through 12 under 35 U.S.C. § 103 are also sustained.

Claim 13

We will not sustain the examiner's 35 U.S.C. § 103 rejection of claim 13. Based on the evidence (i.e., the applied prior art) adduced by the examiner in the rejection of claim 13, we are constrained to reverse the rejection for the following reason.

Claim 13 sets forth the same basic elements (e.g., shaft member, cam, base circle portion, lobe portion, etc.) as claim 1. In addition, claim 13 recites that the shaft member has an outer surface which is impregnated with a solid film lubricant which also impregnates the outer surface of the cam.

We agree with the appellants that the applied prior art fails to provide the needed suggestion or motivation to one of ordinary skill in the art at the time of the appellants' invention to impregnate the outer surface of the shaft member with a solid film lubricant. In fact, none of the applied prior art teaches that it is known to apply a solid film lubricant to the outer surface of the shaft member. Thus, the limitation that "said first and second outer surfaces having an open porosity and are impregnated with a solid film

lubricant comprised of graphite and at least one of molybdenum disulfide and boron nitride in either one of a high temperature polymer and epoxy base, the solid film lubricant has an affinity for oil and promotes rapid formation of a stable oil film to reduce friction therebetween" is not taught or suggested by the applied prior art.

Claims 14 through 18

We have also reviewed the Umeha, Lehtinen and Lachnit references additionally applied in the rejection of claims 17 and 18 but find nothing therein which makes up for the deficiency discussed above with respect to independent claim 13. Since all the limitations recited in independent claim 13 are not taught or suggested by the applied prior art for the reasons expressed supra, we cannot sustain the examiner's rejections of dependent claims 14 through 18 under 35 U.S.C. § 103.

Claim 20

We will not sustain the examiner's 35 U.S.C. § 103 rejection of claim 20. Based on the evidence (i.e., the

applied prior art) adduced by the examiner in the rejection of claim 20, we are constrained to reverse the rejection for the following reason.

Claim 20 sets forth the same basic elements (e.g., shaft member, cam, base circle portion, lobe portion, etc.) as claim 1. In addition, claim 20 recites that a solid film lubricant which impregnates the outer surface of the cam also impregnates the outer surfaces of the shaft member and a bearing member on the shaft member.

We agree with the appellants that the applied prior art fails to provide the needed suggestion or motivation to one of ordinary skill in the art at the time of the appellants' invention to impregnate the outer surfaces of the shaft member and the bearing member with a solid film lubricant. In fact, none of the applied prior art teaches that it is known to apply a solid film lubricant to the outer surface of the shaft member or that it is known to apply a solid film lubricant to the outer surface of the bearing member. Thus, the limitation that "said first and second and third outer surfaces having an

open porosity and are impregnated with a solid film lubricant, the solid film lubricant has an affinity for oil and promotes rapid formation of a stable oil film to reduce friction therebetween" is not taught or suggested by the applied prior art.

New grounds of rejection

Inasmuch as the basic thrust of our affirmance of the 35 U.S.C. § 103 rejections of claims 1 through 3 and 5 through 12 differs from the rationale advanced by the examiner for the rejection, we hereby designate the affirmance to be new grounds of rejection pursuant to 37 CFR § 1.196(b) to allow the appellants a fair opportunity to react thereto (see In re Kronig, 539 F.2d 1300, 1302-03, 190 USPQ 425, 426-27 (CCPA 1976)).

CONCLUSION

To summarize, the decision of the examiner to reject claims 1 through 3 and 5 through 12 under 35 U.S.C. § 103 is affirmed, with the affirmance constituting new grounds of rejection under 37 CFR § 1.196(b) and the decision of the

examiner to reject claims 13 through 18 and 20 under 35 U.S.C. § 103 is reversed.

Any request for reconsideration or modification of this decision by the Board of Patent Appeals and Interferences based upon the same record must be filed within one month from the date of the decision. 37 CFR § 1.197. Should the appellants elect to have further prosecution before the examiner in response to the new rejections under 37 CFR § 1.196(b) by way of amendment or showing of facts, or both, not previously of record, a shortened statutory period for making such response is hereby set to expire two months from the date of this decision.

No period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART; 37 CFR § 1.196(b)

HARRISON E. McCANDLISH, Senior)

Administrative Patent Judge	)
	)
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	) BOARD OF PATENT
JAMES M. MEISTER	) APPEALS
Administrative Patent Judge	) AND
	) INTERFERENCES
	)
	)
	)
JEFFREY V. NASE	)
Administrative Patent Judge	)

Appeal No. 96-3374
Application No. 08/115,974

BLISS MCGLYNN, P.C.
2075 WEST BIG BEAVER ROAD
SUITE 600
TROY, MI 48084

APPENDIX

1. A low friction cam shaft for actuating at least one valve of an internal combustion engine comprising:

a shaft member extending longitudinally;

at least one cam secured to said shaft member; and

said at least one cam being made of a plurality of density metal materials, said at least one cam having a base circle portion and a lobe portion made of one of said density metal materials, said base circle portion having an interior portion made of another of said density metal materials, said interior portion having a porosity less than said lobe portion and a remainder of said base circle portion, said base circle portion and said lobe portion having an outer surface with an open porosity and are impregnated with a solid film lubricant that has an affinity for oil and promotes rapid formation of a stable oil film to reduce friction therebetween.

13. A low friction cam shaft for actuating at least one valve of an internal combustion engine comprising:

a shaft member extending longitudinally and having a first outer surface;

at least one cam secured to said shaft member having a base circle portion and lobe portion, said base circle and lobe portions having a second outer surface, said first and second outer surfaces having an open porosity and are

impregnated with a solid film lubricant comprised of graphite and at least one of molybdenum disulfide and boron nitride in either one of a high temperature polymer and epoxy base, the solid film lubricant has an affinity for oil and promotes rapid formation of a stable oil film to reduce friction therebetween.

20. A low friction cam shaft for actuating at least one valve of an internal combustion engine comprising:

a shaft member extending longitudinally and having a first outer surface;

at least one cam secured to said shaft member having a base circle portion and lobe portion, said base circle and lobe portions having a second outer surface,

wherein an interior portion of said base circle portion is a soft low carbon steel;

wherein said lobe portion and a remainder of said base circle portion are formed of a porous medium to high carbon Ni-Cr alloy steel; and

at least one bearing member on said shaft member having a third outer surface with at least one furrow extending along the longitudinal direction of said shaft member;

said first and second and third outer surfaces having an open porosity and are impregnated with a solid film lubricant, the solid film lubricant has an affinity for oil and promotes

rapid formation of a stable oil film to reduce friction therebetween.

APPEAL NO. 96-3374 - JUDGE NASE
APPLICATION NO. 08/115,974

APJ NASE

APJ MEISTER

APJ McCANDLISH

DECISION: **AFFIRMED-IN-PART**
1.196(b)

Prepared By: Delores A. Lowe

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1st Rev. 29 Oct 97

FINAL TYPED: